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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention]This invention relates to an organic electroluminescence element.

[0002]

[Description of the Prior Art]In recent years, research of the organic electroluminescence element (henceforth an "organic EL device") which organic materials were beginning to be used and uses such organic materials as the hole transporting material and electron transport material which constitute an electroluminescent element is done actively. In the organic materials which constitute this organic EL device, to be what has the outstanding endurance, and to be that from which high luminous efficiency is acquired are demanded.

[0003]As organic materials which have hole transporting ability, conventionally, Macromolecular organic materials, such as low molecule organic materials, such as arylamine system compounds, such as a diamine derivative and N,N'-diphenyl-N,N'-JI (3-methylphenyl)-4,4'-diaminobiphenyl (henceforth "m-TPD"), and a polyvinyl carbazole, are known. it is alike, and since the above-mentioned low molecule organic materials are lacking in appropriate physical or thermal endurance, when the low molecule organic materials concerned constitute an electron hole transporting bed, the fault that the electron hole transporting bed concerned will deteriorate is during the drive of an organic EL device, or preservation. Since the glass transition point (Tg) is very high, the outstanding endurance, i.e., the electron hole transporting bed which has a long use life, is obtained, but macromolecular organic materials, such as a polyvinyl carbazole. Very highly [luminescence starting potential], since hole transporting ability is not enough, luminous efficiency is low, and there is a problem practically.

[0004]

[Problem(s) to be Solved by the Invention]This invention is made based on the above situations, the purpose has low luminescence starting potential, and its luminous efficiency is

high, and there is in moreover providing the organic electroluminescence element excellent in endurance.

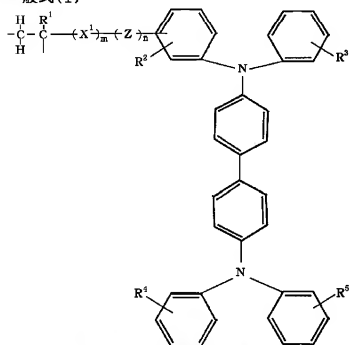
[0005]

[Means for Solving the Problem] An organic electroluminescence element of this invention, It consists of a structural unit (A) expressed with a following general formula (1), and a structural unit (B) expressed with a following general formula (2), and a rate of structural unit (A) concerned and the structural unit (B) concerned is provided with an electron hole transporting bed containing a copolymer which are 5:95-95:5 in a mole ratio.


[0006]


[Formula 3]



一般式(1)



[式中、R¹は水素原子、アルキル基またはアリール基を示し、R²、R³、R⁴およびR⁵は、それぞれ独立に水素原子、アルキル基、アルコキシ基、アリール基またはアミノ基を示す。X¹は

-CH₂-O-CH₂-で表される基または

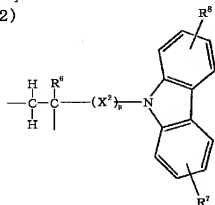
-CH₂-で表される基を示し、Zはオキシカルボニル

基、-N-で表される基またはで表される基を示す。また、繰り返し数mは0または1であり、繰り返し数nは0または1である。]

[0007]

[Formula 4]

一般式(2)



[式中、 R^5 、 R^7 および R^8 は、それぞれ独立に水素原子、アルキル基またはアリール基を示す。 X^2 はフェニレン基またはメチレンフェニレン基を示す。また、繰り返し数 p は 0 または 1 である。]

[0008] In the organic electroluminescence element of this invention, that the rate of said structural unit (A) and said structural unit (B) contains the copolymer which are 20:80-80:20 in a mole ratio has [an electron hole transporting bed] preferred things. As for the organic electroluminescence element of this invention, it is preferred to have a positive electrode layer, said electron hole transporting bed, a luminous layer, and catholyte at least.

[0009]

[Embodiment of the Invention] Hereafter, an embodiment of the invention is described in detail.

Drawing 1 is a sectional view for explanation showing the composition of the organic electroluminescence element concerning a 1st embodiment of this invention. In this organic EL device, the positive electrode layer (hole injection electrode layer) 2 is formed on the transparent substrate 1, the electron hole transporting bed 10 is formed on this positive electrode layer 2, the luminous layer 15 is formed on this electron hole transporting bed 10, and the catholyte (electron injection electrode layer) 3 is formed on this luminous layer 15. And the positive electrode layer 2 and the catholyte 3 are connected to DC power supply 5.

[0010] As the transparent substrate 1, a glass substrate, a transparent resin board, a quartz glass substrate, etc. can be used. As the positive electrode layer 2, what consists of a large (for example, not less than 4 eV) material of a work function, for example, an ITO film, a tin-oxide (SnO_2) film, a copper oxide (CuO) film, a zinc oxide (ZnO) film, etc. can be used. The electron hole transporting bed 10 contains the copolymer (henceforth "a specific copolymer") which consists of a structural unit (A) expressed with the above-mentioned general formula (1), and a structural unit (B) expressed with the above-mentioned general formula (2).

[0011] <Structural unit (A)> In the general formula (1) showing a structural unit (A), R^1 shows a hydrogen atom, an alkyl group, and an aryl group. Here, as an alkyl group, the alkyl group of

the carbon numbers 1-2, such as a methyl group and an ethyl group, is mentioned. A phenyl group is mentioned as an aryl group. And a hydrogen atom and a methyl group are preferred at the point that high polymerization reaction nature is obtained as what shows R^1 in a general formula (1).

[0012] moreover -- even if R^2 in a general formula (1), R^3 , R^4 , and R^5 show a hydrogen atom, an alkyl group, an aryl group, an alkoxy group, and an amino group and their all are the same -- the -- all may differ in part. Here, although not limited especially as an alkyl group, the alkyl group of 1-8 has a preferred carbon number of a methyl group, an ethyl group, a propyl group, a butyl group, a hexyl group, an octyl group, etc. An alkyl group with a large (a carbon number is 8) carbon number is preferred at the point that a methyl group is preferred and high solubility is acquired to an organic solvent in that still higher hole transporting ability is obtained especially. Especially as an alkoxy group, although not limited, the alkoxy group of 1-8 has a preferred carbon number of a methoxy group, an ethoxy basis, a pro BOKISHI group, a butoxy group, etc., and a methoxy group is preferred at the point that still higher hole transporting ability is obtained especially. A phenyl group, a tolyl group, etc. are mentioned as an aryl group. Although not limited, especially as an amino group A diphenylamino group, Diaryl amino groups, such as a ditolylamino group, and a dimethylamino group, The dialkylamino group in which the carbon number of a diethylamino group, a dipropylamino group, etc. has an alkyl group of 1-8 is preferred, and a di-n-propylamino group and a di-i-propylamino group are preferred at the point that still higher hole transporting ability is obtained especially.

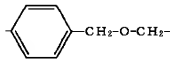
[0013] And in a general formula (1), R^2 is a hydrogen atom, That whose R^3 is an alkyl group, R^2 , and R^3 as a combination of the thing which is a hydrogen atom, R^4 , and R^5 , Either of both is a hydrogen atom and that that whose other is an alkyl group, R^4 , and whose R^5 are alkyl groups is preferred. As for the position, when each of R^2 - R^5 is things other than a hydrogen atom, it is preferred that they are a meta position or the para position.

[0014] In a general formula (1), X^1 shows the basis expressed with the basis or following formula (**) expressed with following formula (b), and its basis expressed with formula (b) is preferred in these. Repetition number m is 0 or 1.

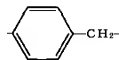
[0015]

[Formula 5]

式(イ)



式(ロ)



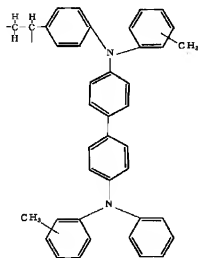
[0016] In a general formula (1), Z shows the basis expressed with an oxycarbonyl group ($-\text{COO}-$), the basis expressed with $-\text{CONH}-$, or $-\text{CONHCO}-$, and an oxycarbonyl group and the basis expressed with $-\text{CONH}-$ are preferred in these. Repetition number n is 0 or 1. As for the basis expressed with $-\text{CH}_2-\text{CR}^1-(\text{X}^1)_m-(\text{Z})_n-$, it is preferred to be located in a meta position or the para position, and being located especially in the para position is preferred.

[0017] A structural unit expressed with a structural unit which a structural unit expressed with a following formula (a), a structural unit expressed with a following formula (b), a structural unit expressed with a following formula (c), etc. are mentioned as a desirable example of a structural unit (A) expressed with a general formula (1), and is expressed especially with a formula (b), and a formula (c) is preferred.

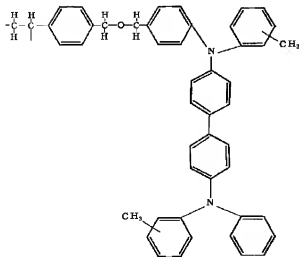
[0018]

[Formula 6]

式 (a)



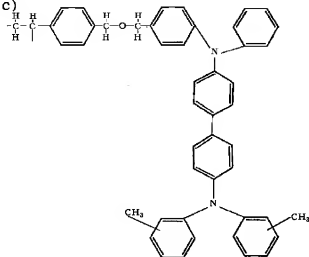
式 (b)



[0019]

[Formula 7]

式 (c)



[0020] a structural unit (B) -- even if R^6 , R^7 , and R^8 show a hydrogen atom, an alkyl group, and an aryl group and their all are the same in the general formula (2) showing a structural unit (B) -- the -- all may differ in part. As an alkyl group, the alkyl group of the carbon numbers 1-8 of a methyl group, an ethyl group, a propyl group, a butyl group, a hexyl group, a 2-ethylhexyl group, an octyl group, etc. is mentioned. As an aryl group, a phenyl group, a tolyl group, a vinyl phenyl group, etc. are mentioned. And in a general formula (2), it is preferred that R^6 is a methyl group and a phenyl group. In a general formula (2), R^7 and R^8 , respectively A methyl group, It is preferred that they are a butyl group and a 2-ethylhexyl group, and it is preferred that either is an alkyl group and the other is a phenyl group as a combination of R^7 and R^8 .

[0021] In a general formula (2), as for X^2 , although a phenylene group or a methylenephenylene group may be shown and this phenylene group and a methylenephenylene group may be any of o-object, m-object, and p-object, it is preferred that they are p-object and m-object. Repetition number p is 0 or 1.

[0022] As an example of a structural unit (B) expressed with a general formula (2), A structural unit expressed with a following formula (d) (structural unit originating in N-vinylcarbazole), A structural unit expressed with a following formula (e) (structural unit originating in N-(4-vinylphenyl) carbazole), A structural unit expressed with a following formula (f) (structural unit originating in N-(p-vinylbenzyl) carbazole), A structural unit expressed with a structural unit (structural unit originating in N-vinyl-3,6 diphenylcarbazole) expressed with a following formula (g), and a following formula (h) (structural unit originating in N-(4-vinylphenyl)-3 and 6 diphenylcarbazole), A structural unit (structural unit originating in N-(p-vinylbenzyl)-3 and 6 diphenylcarbazole) etc. which are expressed with following formula (i) are mentioned, and a

structural unit expressed with a structural unit expressed with a formula (d) and a formula (e) is preferred in these.

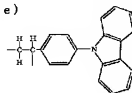
[0023]

[Formula 8]

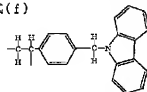
式 (d)



式 (e)



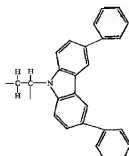
式 (f)



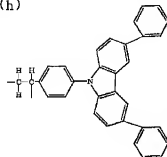
[0024]

[Formula 9]

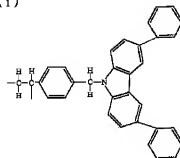
式 (g)



式 (h)



式 (i)



[0025] In the specific copolymer which constitutes the electron hole transporting bed 10, in a mole ratio, the rates of a structural unit (A) and a structural unit (B) are 5:95-95:5, and are 30:70-80:20 preferably [it is desirable and] to 20:80-80:20, and a pan. Electron hole transporting bed 10 charge obtained by becoming what has the heat resistance of a specific copolymer insufficient when too little [the rate of a structural unit (B)] becomes what has low hole transporting ability. On the other hand, when too little [the rate of a structural unit (A)], the electron hole transporting bed 10 obtained becomes what has low hole transporting ability.

[0026] As for the weight average molecular weight of a specific copolymer, it is preferred 3000-1 million, and that it is especially 5000-300000 at the polystyrene conversion by gel permeation chromatography, for example. When this weight average molecular weight is less than 3000, it may become what has insufficient stability and mechanical strength. [in / in the specific copolymer obtained / heat resistance and filmy voice] Since handling nature falls and the cobwebbing nature of a solution arises when that solution viscosity becomes a remarkable high thing easily and forms the electron hole transporting bed 10 with wet process, the specific copolymer obtained on the other hand when this weight average molecular weight exceeds 1

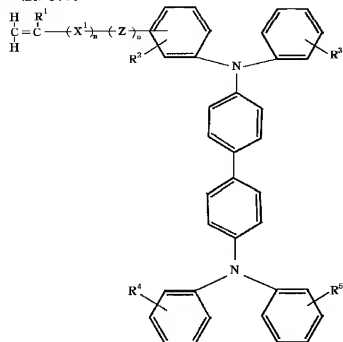
million is not preferred. the ratio of weight average molecular weight and a number average molecular weight -- although M_w/M_n in particular is not limited, it is usually 1-8 and it is preferred that it is a value nearer to 1.

[0027]An arylamine system compound (henceforth "a specific arylamine system compound") by which such a specific copolymer is expressed with a following general formula (3), A carbazole derivative (henceforth "a specific carbazole derivative") expressed with a following general formula (4), It is obtained the proper polymerizing method, for example, a radical polymerization method, an anionic polymerization method or a cationic polymerization method, and by carrying out copolymerization preferably by those corresponding living-radical-polymerization methods, living anionic polymerization method, or a living-cationic-polymerization method.

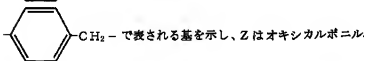
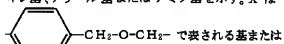
[0028]

[Formula 10]

一般式(3)



[式中、 R^1 は水素原子、アルキル基またはアリール基を示し、 R^2 、 R^3 、 R^4 および R^5 は、それぞれ独立に水素原子、アルキル基、アルコキシ基、アリール基またはアミノ基を示す。 X^1 は

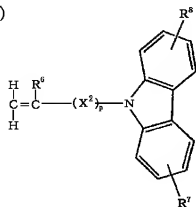


基、 —C(=O)N— で表される基または —C(=O)N—C(=O)— で表される基を示す。また、繰り返し数 m は 0 または 1 であり、繰り返し数 n は 0 または 1 である。]

[0029]

[Formula 11]

一般式(4)



[式中、 R^6 、 R^7 および R^8 は、それぞれ独立に水素原子、アルキル基またはアリール基を示す。 X^3 はフェニレン基またはメチレンフェニレン基を示す。また、繰り返し数 p は0または1である。]

[0030]In obtaining a specific copolymer by the usual radical polymerization method, The radical polymerization method using publicly known radical initiators, such as dithiocarbamate derivatives, such as peroxides, such as azo compounds, such as azobisisobutyronitrile (azobisisobutyronitrile), and benzoyl peroxide (BPO), and a tetraethylthiuram disulfide, as a polymerization catalyst can be used. In obtaining a specific copolymer by a living-radical-polymerization method, N-oxy radicals, such as 2,2,6,6-tetramethyl 1-piperidine- N-oxide (TEMPO), The living-radical-polymerization method by the living-radical-polymerization method by the catalyst system which combined the above-mentioned radical polymerization initiator, atom transfer polymerization, etc. can be used. The using rate of such radical polymerization catalyst is 1-0.00001 mol to 1 mol of monomers. In such a radical polymerization method, as a polymerization solvent, Amide system solvents, such as dimethylformamide, dimethylacetamide, and N-methyl pyrrolidone, Hydrocarbon system solvents, such as benzene, toluene, xylene, hexane, and cyclohexane, Ester solvent, such as gamma-butyrolactone and ethyl lactate, cyclohexylbenzophenone, Ether system solvents, such as aliphatic series ether, such as cyclic ether, such as ketone solvent, such as cyclohexanone, 2-ethylpentanone, and ethyl isoamyl ketone, and a tetrahydrofuran, and diethylene glycol dimethyl ether, can be used. Reaction temperature is 0-200 **, for example, and the reaction time is 0.5 to 72 hours, for example.

[0031]In obtaining a specific copolymer by the usual anionic polymerization method, For example, an alfin catalyst of naphthyl sodium etc., methyl lithium, Aryl lithium, such as alkyl lithium, such as ethyllithium and butyl lithium, and phenyllithium, An anionic polymerization method using an organic metallic compound by metal, such as alkaline metals, such as ate-complexes, such as dialkylzincs, such as diethylzinc, lithium alkyl magnesium, and lithium alkyl barium, and alkaline-earth metals, as an anionic polymerization catalyst can be used. Especially as an anionic polymerization catalyst, it is preferred to use organolithium

compounds, such as n-butyl lithium, sec-butyl lithium, and phenyllithium. When obtaining a specific copolymer by a living anionic polymerization method, a living anionic polymerization method by a catalyst of butyl lithium etc. can be used. A using rate of such an anionic polymerization catalyst is 0.1-0.00001 mol to 1 mol of monomers. In such an anionic polymerization method, ether compounds, such as hydrocarbon, such as benzene, toluene, hexane, heptane, and cyclohexane, a tetrahydrofuran, and dioxane, etc. can be used as a polymerization solvent. Reaction temperature is -50-100 **, for example, and the reaction time is 5 minutes - 24 hours, for example.

[0032]When obtaining a specific copolymer by the usual cationic polymerization method, a cationic polymerization method using publicly known cationic polymerization catalysts, such as inorganic acid, such as Lewis acid, such as trifluoro borate and a tin tetrachloride, sulfuric acid, and chloride, and cation exchange resin, can be used. When obtaining a specific copolymer by a living-cationic-polymerization method, a living-cationic-polymerization method by catalysts, such as HI and HI-ZnI_2 , can be used. A using rate of such a cationic polymerization catalyst is 0.01-0.00001 mol to 1 mol of monomers. In such a cationic polymerization method, as a polymerization solvent, High polar solvents, such as cyclic ether, such as halogenated hydrocarbon represented by methylene chloride, chlorobenzene, etc., dibutyl ether, diphenyl ether, dioxane, and a tetrahydrofuran, acetonitrile, and nitrobenzene, etc. can be used. Reaction temperature is -150-50 **, for example, and the reaction time is 0.01 to 12 hours, for example.

[0033]Various colors, a laser pigment, etc. may contain in the electron hole transporting bed 10, and, as for the rate, it is preferred to it that it is 0.1 to 10 mass [of all the materials which constitute the electron hole transporting bed 10] %. Luminescence is promoted and an organic EL device obtained when such a color, a laser pigment, etc. contain in the electron hole transporting bed 10 has a still longer use life.

[0034]As a luminescent material which constitutes the luminous layer 15, a metal complex compound of hydroxyquinoline represented by trisquinolate ARUMINAMU, a metal complex compound of hydroxy benzoxazole and a hydroxybenzthiazole, etc. can be used. As the catholyte 3, a metal membrane which consists of what consists of a small (for example, 4 eV or less) material of a work function, for example, aluminum, calcium, magnesium, lithium, indium, etc., an alloy film of these metal, or an alloy film of these metal and other metal can be used. Although thickness in particular of the electron hole transporting bed 10 and the luminous layer 15 is not limited, it is usually preferably chosen in 50-200 nm 10-1000 nm.

[0035]Such an organic EL device can be manufactured as follows, for example. First, form the positive electrode layer 2 in the surface of the transparent substrate 1, and on the surface of this positive electrode layer 2. By heat-treating a coating film in which other materials used [a specific copolymer and if needed] were obtained by applying an electron hole transporting bed

formation solution which it comes to dissolve into a proper organic solvent, an organic solvent in the coating film concerned is removed, and the electron hole transporting bed 10 is formed. Subsequently, an organic EL device of composition of forming the luminous layer 15 in the surface of the electron hole transporting bed 10, and forming the catholyte 3 in the surface of the luminous layer 15 after that, with being shown in drawing 1 is manufactured.

[0036]As a method of above forming the positive electrode layer 2, a vacuum deposition method or a sputtering technique can be used. A commercial material in which it comes to form an ITO film in the surface of transparent substrates, such as a glass substrate, can also be used.

[0037]As an organic solvent for preparing an electron hole transporting bed formation solution, it is used by what may dissolve material (other materials used [a specific copolymer and if needed]) for forming the electron hole transporting bed 10, and as the example, Amide series solvents, such as halogenated hydrocarbon, such as chloroform, chlorobenzene, and tetrachloroethane, dimethylformamide, and N-methyl pyrrolidone, ethyl lactate, PEGUMIA, ethyl ethoxy propionate, methyl amyl ketone, etc. are mentioned. These organic solvents are independent or can be used combining two or more sorts. In these, it is preferred to use what has a suitable vapor rate in that a thin film which has uniform thickness is obtained, and an organic solvent whose boiling point is specifically about 70-150 **. Although a using rate of an organic solvent changes with kinds of material for forming the electron hole transporting bed 10, it is a rate that concentration of material for forming the electron hole transporting bed 10 in an electron hole transporting bed formation solution will usually be 0.1 to 10 % of the weight. As a means to apply an electron hole transporting bed formation solution, a spin coat method, a dipping method, the roll coat method, etc. can be used, for example.

[0038]By carrying out vacuum deposition of the (1) luminescent material to the surface of the electron hole transporting bed 10 as a method of forming the luminous layer 15, Wet process etc. which form the luminous layer 15 can be used by applying to the surface of the electron hole transporting bed 15 a luminous layer formation solution which it comes to dissolve into an organic solvent with proper dry method and (2) luminescent materials which form the luminous layer 15, and heat-treating it. When using wet process, as an organic solvent for preparing a luminous layer formation solution, If a luminescent material may be dissolved, can use various things and as the example, Aromatic hydrocarbon, such as toluene and xylene, methyl isobutyl ketone, Halogenated compounds, such as alcohols, such as amide, such as ester species, such as ketone, such as cyclohexanone, ethyl lactate, and gamma-butyrolactone, and N-methyl pyrrolidone, and 2-ethylhexanol, and tetrachloroethane, etc. are mentioned. Although a using rate of an organic solvent changes with kinds of luminescent material, it is usually a rate that concentration of a luminescent material in a luminous layer formation solution will be 0.5 to 10 % of the weight. As a means to apply a luminous layer formation solution, a spin coat

method, a dipping method, the roll coat method, etc. can be used, for example. As a method of forming the catholyte 3, a vacuum deposition method or sputtering process can be used.

[0039]In an organic EL device concerning a 1st above-mentioned embodiment, by DC power supply 5, if direct current voltage is impressed between the positive electrode layer 2 and the catholyte 3, the electron hole transporting bed 10 and the luminous layer 15 will emit light, and this light will be emitted via the positive electrode layer 2 and the glass substrate 1. The electron hole transporting bed 10 contains a specific copolymer which consists of a structural unit (A) and a structural unit (B), sake, an organic EL device of such composition has low luminescence starting potential, and its luminous efficiency is high, and, moreover, it is excellent in endurance.

[0040]Drawing 2 is a sectional view for explanation showing composition of an organic EL device concerning a 2nd embodiment of this invention. This organic EL device is the same composition as an organic EL device concerning a 1st embodiment except the electron transport layer 20 being formed on the luminous layer 15, and the catholyte 3 being formed on this electron transport layer 20. As a material which constitutes the electron transport layer 20, a metal complex of quinoline compounds, such as a 8-hydroxyquinoline derivative, Polymer etc. which contain oxadiazole system compounds, such as screw naphthyl oxadiazole, p-t-buthylphenyl biphenyl oxadiazole, and 2-naphthyl 5-phenyl-oxadiazole, or such residue in a side chain can be used. After such an electron transport layer 20 dissolves dry methods, such as a vacuum deposition method and a sputtering technique, and an electron transport material in a proper solvent, it can be formed with wet process which applies this solution by spin coat method, dip method, the ink jet method, print processes, etc., and dries it. It is preferred by carrying out vapor codeposition of an electron transport material, and an above-mentioned alkaline metal or alkaline-earth metals especially to form the electron transport layer 20. According to the organic EL device concerning this 2nd embodiment, the same effect as an organic EL device concerning a 1st above-mentioned embodiment is acquired. since the electron transport layer 20 is formed -- base of a hole (electron hole) -- an omission is prevented, and transportation of an electron can become smooth, luminescence starting potential can fall further, and much more improvement in luminous efficiency can be aimed at further.

[0041]Drawing 3 is a sectional view for explanation showing composition of an organic EL device concerning a 3rd embodiment of this invention. This organic EL device is the same composition as an organic EL device concerning a 2nd embodiment except the electronic injection layer 25 being formed on the electron transport layer 20, and the catholyte 3 being formed on this electronic injection layer 25. As a material which constitutes the electronic injection layer 25, LiF, MgF₂, Metallic oxides, such as metal fluorides, such as CsF, AlO₃, and SrO, A work function of material which constitutes an anode and an electron transport layer

from compounds, such as a complex of metal, such as aluminum, Even if this electronic injection layer 25 that can be suitably chosen in consideration of a LUMO level is formed in an entire surface of the electron transport layer 20, where the surface concerned is dotted, it may be formed, and about 0.1-20 nm of that thickness may be sufficient. Such an electronic injection layer 25 can be formed with dry methods, such as a vacuum deposition method and a sputtering technique. According to the organic EL device concerning this 3rd embodiment, the same effect as an organic EL device concerning the 1st above-mentioned embodiment and 2nd embodiment is acquired. Since the electronic injection layer 25 is formed, pouring of an electron from an anode can become smooth, luminescence starting potential can fall further, and much more improvement in luminous efficiency can be aimed at further.

[0042]Drawing 4 is a sectional view for explanation showing composition of an organic EL device concerning a 4th embodiment of this invention. This organic EL device is the same composition as an organic EL device concerning a 1st embodiment except the hole injection layer 30 being formed on the positive electrode layer 2, and the electron hole transporting bed 10 being formed on this hole injection layer 30. As a material which constitutes the hole injection layer 30, a complex etc. of a copper phthalocyanine, poly aniline, a polythiophene, polyethylene dioxythiophene marketed with a trade name "PEDOT" (made by a Beyer company), and polystyrene sulfonate can be used. After such a hole injection layer 30 dissolves dry methods, such as a vacuum deposition method and a sputtering technique, and an electron transport material in a proper solvent, it can be formed with wet process which applies this solution by spin coat method, dip method, the ink jet method, print processes, etc., and dries it. The thickness is 1-100 nm. According to the organic EL device concerning this 4th embodiment, the same effect as an organic EL device concerning a 1st above-mentioned embodiment is acquired. Since the hole injection layer 30 is formed, a pouring obstacle of a hole can be prevented.

[0043]Drawing 5 is a sectional view for explanation showing composition of an organic EL device concerning a 5th embodiment of this invention. This organic EL device is the same composition as an organic EL device concerning a 4th embodiment except the electron transport layer 20 being formed on the luminous layer 15, and the catholyte 3 being formed on this electron transport layer 20. As a material which constitutes the electron transport layer 20, the same thing as an organic EL device concerning a 2nd embodiment can be used. According to the organic EL device concerning this 5th embodiment, the same effect as an organic EL device concerning the 1st above-mentioned embodiment, 2nd embodiment, and 4th embodiment is acquired.

[0044]Drawing 6 is a sectional view for explanation showing composition of an organic EL device concerning a 6th embodiment of this invention. This organic EL device is the same composition as an organic EL device concerning a 5th embodiment except the electronic

injection layer 25 being formed on the electron transport layer 20, and the catholyte 3 being formed on this electronic injection layer 25. As a material which constitutes the electronic injection layer 25, the same thing as an organic EL device concerning a 3rd embodiment can be used. According to the organic EL device concerning this 6th embodiment, the same effect as an organic EL device concerning the 1st above-mentioned embodiment - 4th embodiment is acquired.

[0045]

[Example] Hereafter, although the example of this invention is described, this invention is not limited to these. A "part" means a "mass part" below.

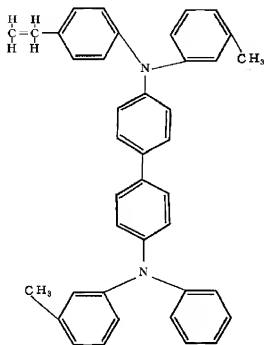
[0046] [Composition of a copolymer]

<Synthetic example 1> Compound (henceforth "compound (I)") 70 millimol expressed with following formula (I) under a nitrogen air current in this pressure bottle after nitrogen gas replaces the inside of a pressure bottle with a capacity of 50 ml, 50 ml of toluene was added with N-vinylcarbazole 30 millimol, and compound (I) and N-vinylcarbazole were dissolved in toluene. Stirring this solution, azobisisobutyronitrile 10 millimol was added as radical polymerization catalyst in the solution concerned, and the polymer solution was obtained by raising this system at 70 °C from a room temperature, and performing a radical polymerization on the reaction temperature of 70 °C, and the conditions of reaction-time 20 hours. Polymers were collected by solidifying a polymer by throwing in the obtained polymer solution in the 50 times as many methanol of quantity. Reprecipitation refining of this polymer was carried out with the conventional method, and reduced pressure drying was carried out for one day at 50 °C after that. Hereafter, the obtained polymer is called polymer (1). The structural unit (structural unit expressed with a formula (a)) to which this polymer (1) originates in compound (I) about the obtained polymer (1) when spectrum analysis of an infrared absorption spectrum is conducted, it was checked that it is a copolymer which consists of a structural unit (structural unit expressed with a formula (d)) originating in N-vinylcarbazole. In this polymer (1), the rate of the structural unit (A) and structural unit (B) which were searched for using the analytical curve was 70:30 in the mole ratio.

[0047]

[Formula 12]

式(1)

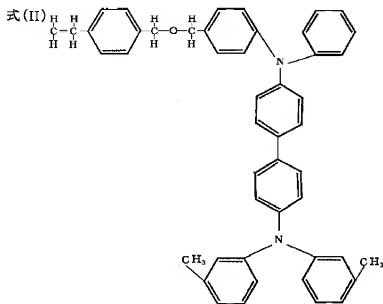


[0048]The weight average molecular weight Mw of a polymer (1) is 30000 in the polystyrene conversion by gel permeation chromatography (solvent: tetrahydrofuran). the ratio of weight average molecular weight and a number average molecular weight -- Mw/Mn was 2.6.

[0049]<Synthetic example 2> Instead of compound (I) 70 millimol, the polymer was obtained like the synthetic example 1 except having changed the amount of N-vinylcarbazole used into 50 millimols, using compound (henceforth "compound (II)") 50 millimol expressed with following formula (II). Hereafter, the obtained polymer is called polymer (2). The structural unit (structural unit expressed with a formula (c)) to which this polymer (2) originates in compound (II) about the obtained polymer (2) when spectrum analysis of an infrared absorption spectrum is conducted, It was checked that it is a copolymer which consists of a structural unit (structural unit expressed with a formula (d)) originating in N-vinylcarbazole. In this polymer (2), the rate of the structural unit (A) and the structural unit (B) was 50:50 in the mole ratio.

[0050]

[Formula 13]



[0051]The weight average molecular weight Mw of a polymer (2) is 38000 in the polystyrene conversion by gel permeation chromatography (solvent: tetrahydrofuran).
the ratio of weight average molecular weight and a number average molecular weight -- Mw/Mn was 1.95.

[0052]<Synthetic example 3> The polymer was obtained like the synthetic example 1 except having used compound (II)50 millimol and having used N-(4-vinylphenyl) carbazole 50 millimol instead of N-vinylcarbazole 30 millimol instead of compound (I)70 millimol. Hereafter, the obtained polymer is called polymer (3). The structural unit (structural unit expressed with a formula (c)) to which this polymer (3) originates in compound (II) about the obtained polymer (3) when spectrum analysis of an infrared absorption spectrum is conducted, It was checked that it is a copolymer which consists of a structural unit (structural unit expressed with a formula (e)) originating in N-(4-vinylphenyl) carbazole. In this polymer (3), the rate of the structural unit (A) and the structural unit (B) was 50:50 in the mole ratio.

[0053]The weight average molecular weight Mw of a polymer (3) is 33000 in the polystyrene conversion by gel permeation chromatography (solvent: tetrahydrofuran).
the ratio of weight average molecular weight and a number average molecular weight -- Mw/Mn was 2.55.

[0054]<Example 1> The electron hole transporting bed formation solution was prepared by dissolving two copies of polymers (1) in 100 copies of m-xylene. The charge of a laminated material which comes to form an ITO film (positive electrode layer) in the surface of the transparent substrate which consists of glass of a 5-cm angle is prepared, After applying the prepared electron hole transporting bed formation solution to the surface of the ITO film in this

charge of a laminated material by a spin coater, the 25-nm-thick electron hole transporting bed was formed in it by performing the solvent wiping removal of the organic solvent by heat-treatment. Subsequently, on this electron hole transporting bed, with a vacuum deposition method, form the luminous layer which consists of 50-nm-thick trisquinolate ARUMINAMU, and on the surface of this luminous layer with a vacuum deposition method. When thickness formed magnesium of 5 nm squares, and a silver alloy film (catholyte) at 200 nm, the organic EL device of composition of being shown in drawing 1 was manufactured.

[0055]<Example 2> Instead of the polymer (1), the organic EL device was manufactured like Example 1 except having used the polymer (2).

[0056]<Example 3> Instead of the polymer (1), the organic EL device was manufactured like Example 1 except having used the polymer (3).

[0057]<Comparative example 1> Instead of the polymer (1), the organic EL device was manufactured like Example 1 except having used the polymer of m-TPD.

[0058]<Comparative example 2> Instead of the polymer (1), the organic EL device was manufactured like Example 1 except having used the polyvinyl carbazole.

[0059][Evaluation of an organic EL device]

Luminescence starting potential and the highest light emitting luminance : (1) As opposed to each of the organic EL device concerning Example 1 - Example 3 and the comparative example 1 - the comparative example 2, By using an ITO film as an anode and impressing direct current voltage by using the alloy film of magnesium and silver as a cathode, the luminous layer was made to emit light and the highest light emitting luminance was measured with the luminance meter "LS-100" (made by Minolta Co., Ltd.). The luminescence starting potential at that time was measured with the voltmeter "R8240" (made by ADVANTEST).
Endurance : (2) About each of the organic EL device concerning Example 1 - Example 3 and the comparative example 1 - the comparative example 2. The luminous layer was made to emit light, where force current is fixed at 15 mA, time (half-life) until the light emitting luminance drops from a luminescence start to 1/2 of early light emitting luminance was measured, and the relative value (henceforth a "reduction-by-half life") when half-life of the organic EL device concerning the comparative example 2 was set to 100 was calculated. As mentioned above, a result is shown in the following table 1.

[0060]

[Table 1]

	実施例 1	実施例 2	実施例 3	比較例 1	比較例 2
発光開始電圧 (V)	6.5	6.2	6.5	6.3	14
最高発光輝度 (cd/m^2)	17000	15000	18000	13000	4000
半減寿命	3500	2500	3300	500	100

[0061]The organic EL device concerning Example 1 - Example 3 so that clearly from Table 1, Compared with the organic EL device concerning the comparative example 1 - the comparative example 2, light emitting luminance was high, and luminescence starting potential was low compared with the organic EL device concerning the comparative example 2, and it was checked that it is what has the endurance outstanding compared with the organic EL device concerning the comparative example 1 - the comparative example 2 moreover.

[0062]

[Effect of the Invention]As explained above, according to this invention, luminescence starting potential is low, luminous efficiency is high, and, moreover, the organic electroluminescence element excellent in endurance can be provided.

[Translation done.]